CLAIMS

We claim:

1. A vaporization apparatus for multi-component working fluids comprising:
a heat transfer apparatus including:
a liquid shell having:
a liquid stream input;
a heat source stream input; and
a heat source stream output,
a vapor shell having
a vapor stream output; and
a plurality of pipes interconnecting the liquid shell and the vapor shell;
where the heat transfer apparatus is designed to receive an input liquid stream comprising a multi-component working fluid through its liquid input so that liquid fills an entire volume of the liquid shell, the connecting tubes and a lower portion of the vapor shell, which maintains nucleate boiling in the liquid shell and equilibrates the vapor and the liquid in the heat transfer apparatus.

2. The vaporization apparatus of claim 1, wherein the liquid shell further includes:
a non-vaporized liquid stream output.

3. The vaporization apparatus of claim 1, wherein the vapor shell further includes:
a vapor stream input.

4. A system for extracting heat from a heat source and converting a portion of the heat into a useable form of energy comprising:
a vaporization apparatus of claim 1-3, and
a heat extraction apparatus,
where heat from a heat source stream is transferred to a liquid multi-component working fluid stream having a given composition in the vaporization apparatus to produce a vapor multi-component working fluid stream having a substantially identical composition and where thermal energy transferred from the heat source stream to the vapor multi-component working fluid stream is converted into a more useable form of energy in the heat extraction apparatus.

5. A method for vaporizing a liquid multi-component working fluid comprising the steps of:

feeding a liquid multi-component working fluid stream into a multi-component working fluid vaporization apparatus of claims 1-3 from a energy production facility,

inputting heat from a heat source into the multi-component working fluid vaporization apparatus,

transferring the heat from the heat source to the liquid multi-component working fluid stream to produce a vapor multi-component working fluid stream; and

sending the vapor multi-component working fluid stream back to the energy production facility,

where the liquid multi-component working fluid and the vapor multi-component working fluid have substantially the same composition and the vaporization apparatus maintains substantially nucleate boiling throughout all heat exchange units. having a given composition into a vapor multi-component working fluid having substantially the same composition, where the method

6. A methods for vaporizing a multi-component working fluid comprising the steps:

feeding an input liquid multi-component working fluid stream having a given composition into an n^{th} heat transfer apparatus comprising an n^{th} heat exchange unit and an n^{th} vapor removal unit;

transferring heat from a heat source in the n^{th} heat exchange unit to the input liquid multi-component working fluid stream, where the heat causes a portion of the input liquid multi-component working fluid stream to boil;

removing vapor formed during the boiling via the n^{th} vapor removal unit to form an n^{th} vapor stream having a richer composition than the input liquid stream and an n^{th} liquid stream having a higher temperature and a leaner composition than the input liquid stream;

forwarding the n^{th} liquid stream to an $n\text{-}1^{th}$ heat transfer apparatus comprising an $n\text{-}1^{th}$ heat exchange unit and an $n\text{-}1^{th}$ vapor removal unit;

transferring heat from the heat source in the $n\text{-}1^{th}$ heat exchange unit to the n^{th} liquid stream, where the heat causes a portion of the n^{th} liquid stream to boil;

removing vapor formed during the boiling via the $n\text{-}1^{th}$ vapor removal unit to form an $n\text{-}1^{th}$ vapor stream having a richer composition than the n^{th} liquid stream and an $n\text{-}1^{th}$ liquid stream having a higher temperature and a leaner composition than the n^{th} liquid stream;

repeating the forwarding, transferring and removing step, while decrementing the counter

by 1 until the counter has a numeric value of 1;

forwarding the 1st liquid stream formed in the 1st removing step and all of the vapor streams to a scrubber;

equilibrating the 1st liquid stream and the vapor streams in the scrubber to produce a vapor multi-component working fluid stream having a composition substantially identical to the composition of input liquid multi-component working fluid stream and a remaining liquid stream; and

combining the remaining liquid stream from the scrubber with one of the liquid stream prior to forwarding that liquid stream to the next heat transfer apparatus, where that liquid stream has a temperature and composition that most closely matches a temperature and composition of the remaining liquid stream,

where vapor removal units associated with each heat transfer apparatus insure that substantially nucleate boiling occurs throughout each heat exchange unit.